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ABSTRACT

The first article, "LOGO and von Neumann Ideas," deals with the creation of new procedures based on procedures defined and stored in memory as LOGO lists of lists. This representation, which enables LOGO procedures to construct, modify, and run other LOGO procedures, is compared with basic computer concepts first formulated by John von Neumann. The second paper, "Towards a Humanistic Use of Computers in Education," argues that integration of computers in classrooms does not necessarily imply an improvement in the quality of education; rather, computer applications must be related to a cognitive view of learning that fosters the development of a harmonious relationship among culture, science, and human values. Some of the principles of LOGO programming system/language are analyzed as it generates a structure through which computers can effectively improve learning conditions while respecting, at the same time, the learner's linguistic and cultural identity. A Spanish translation of the second paper is included. (LMM)

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LOGO AND VON NEUMANN IDEAS

by Horacio C. Reggini

SEPTEMBER 1983

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Logo and von Neumann ideas

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SUMMARY

Article deals with the creation of new procedures based on procedures defined and stored in memory as Logo lists of lists. The representation of Logo procedures as lists of lists so that Logo procedures can construct, modify and run other Logo procedures is compared to basic computer concepts first formulated by John von Neumann decades ago.

LOGO and von Neumann's ideas

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Introduction

The knowledge of history allows us to better understand the present and gives us experience and wisdom to plan for the future. Also, it is always advisable to return to the sources, to the origins of facts and discoveries so as to gain a more perfect understanding of their consequences. In the light of these thoughts, we will return to the original works of John von Neumann, to whom we owe the first concepts on computers, which he summarized in a small book (The Computer and the Brain, Yale University Press Inc., 1958). Von Neumann's phrases provided an excellent explanation of the new category of machines. We will give particular attention to the notion of "stored program". Let us remember that one of the features of computers is their continuous operation without human intervention. The reason for this is that the orders governing the machine are stored in its memory. Anyone who has sometime designed a program in machine language, internal language or absolute language, as it was indistinctly called many years ago, knows that an instruction consists, for example, of a series of numbers (zeros and ones) designating, the first ones, the type of operation to be performed, and the subsequent ones, the memory areas to be acted on. The control system interprets the code of the order, carries it out and goes ahead with the following instruction. John von Neumann wrote in this respect:

"An order is, in most embodiments of this scheme, physically the same thing as a number (of the kind with which the machine deals). An order must indicate which basic operation is to be

performed, from which memory registers the inputs of that operation are to come, and to which memory registers its output is to go. ...an order is usually "physically" the same thing as a number. Hence the natural way to store it - in the course of the problem in whose control it participates - is in a memory register. In other words, each order is stored in the memory, in a definite memory register, that is to say, at a definite address. This opens up a number of specific ways to handle the matter of an order's successor. ...the orders are ideal entities, stored in the memory and it is thus the contents of this particular segment of the memory that express the problem."

Von Neumann explained the way in which the system acted on memory registers and in which an order could modify another one, as follows:

"Since the orders that exercise the entire control are in the memory, a higher degree of flexibility is achieved than in any previous mode of control. Indeed the machine, under the control of its orders, can extract numbers (or orders) from the memory, process them (as numbers!), and return them to the memory (to the same or to other locations); i.e., it can change the contents of the memory - indeed this is its normal modus operandi. Hence it can, in particular, change the orders (since these are in the memory!) - the very orders that control its action. Thus all sort of sophisticated order-systems become possible, which keep successively modifying themselves and hence also the computational processes that are likewise under their control."

The preceding idea, an inspired and extremely important one, of a recurrence or action of instructions upon themselves, is the essential feature of computers and that which, on the basis of the physical advances of recent years, is creating the possibility

of multiple developments and uses.

Lately, new computers are being mentioned which would not follow von Neumann's outline, leading to a bottleneck situation as instructions must be carried out one by one. Therefore, new computers are designed ("dataflow" or "binary-tree" type) for the simultaneous processing of many instructions. But von Neumann's fruitful idea of storing instructions in modifiable registers and the possibility of changing instructions is still valid and is the notion that allows for the appearance of all new alternatives.

LOGO capacities

We all know that the learning of the LOGO language is one of the most interesting ways of access to the world of computers. Its simplicity, power and possibility of use in all the fields of human endeavor may finally turn it into the most widely used programming language in the next few years. To the preliminary implementations of LOGO presently available, no doubt others will follow, more powerful and complete, which will permit its effective use in commercial activities, industry, science and technology, etc.

We also know that the LOGO system is so simple and natural that even a child can understand it. Thus, with LOGO, computers become useful tools in the educational process. But LOGO is not a "toy", a language to be used only by children. That impression, prevailing in some circles, is due to the fact that most of the first instances of LOGO use illustrated elementary procedures for children and/or adult beginners lacking any previous computation knowledge.

In LOGO, it is possible to define new words and orders that may later be used exactly as the original words. We usually teach the machine every new order by means of the word TO, then we add the name of the order and then, one after the other, the different words or instructions that define the procedure. In LOGO, procedures are represented as lists of lists, so that they may be constructed, modified and processed also by means of other procedures. In other words, we can operate directly with the LOGO language in a way similar to the one earlier described by von Neumann: the modification or creation of a procedure by means of another procedure. To that effect, we will explain the primitive orders DEFINE and TEXT. Before doing that, we will review some orders for the processing of lists.

Orders associated to lists

Primitive orders BUTFIRST (in short, BF) and BUTLAST (BL), through which we may suppress the FIRST or the LAST item of a list, are well known.

Primitive orders to enter an item at the beginning or at the end of a list are FPUT and LPUT, respectively.

For example:

```
FPUT "LEARNING [TO ENJOY]
```

outputs

```
[LEARNING TO ENJOY]
```

Similarly:

LPUT "LEARNING [TO ENJOY]

outputs

[TO ENJOY LEARNING]

The order SENTENCE (SE) applied, in this case, to the same example, produces similar outputs. Instead, the result will be different when the item to be entered is a list. FPUT and LPUT enter the new item as a sublist:

For example:

FPUT [THE POWER] [OF IDEAS]

outputs

[[THE POWER] OF IDEAS]

Instead:

SENTENCE [THE POWER] [OF IDEAS]

outputs

[THE POWER OF IDEAS]

The orders FPUT and LPUT permit us to construct lists of sublists - which is how procedures are represented in LOGO - of the following type:

[[ ][ ][ ]... [ ][ ][ ]]

If the sublists of the list previously outlined were LOGO instructions, the following procedure would start their execution:

```
TO EXECUTE  :LIST
IF  :LIST = [ ] STOP
RUN FIRST  :LIST
EXECUTE BF  :LIST
END
```

Let us remember, in order to understand the procedure EXECUTE, that the argument of the order RUN is a LOGO order or a succession of LOGO orders.

For example:

```
RUN  [FD 50 RT 45 BK 15]
```

LOGO orders between square brackets - to draw the number 1 - follow each other (with no brackets between them).

Another example:

```
MAKE "ORDER [PRINT]
RUN LPUT [O.K.]  :ORDER
```

results in O.K.

DEFINE and TEXT orders

The primitive order DEFINE gives another important alternative

for the creation of a procedure, in addition to the one usually employed by means of the order TO. It is possible to use it directly as an isolated order or within another procedure. Thus, already defined procedures can be modified, previous procedures can be linked to others, etc. Von Neumann's notion of instructions or groups of instructions acting on other instructions can thus be carried out in LOGO.

The scope of possibilities which can be realized by means of this potentiality of LOGO is unlimited. The notion of procedures as lists of sublists, all of them located in the memory and all of them capable of acting on the others, has a colossal strength and power: in summary, it is the concretion of von Neumann's ideas.

The order DEFINE consists of two arguments: the first is the name of the procedure, the second is a list of lists; the first list (sublist) states the arguments of the new procedure, then successive lists (sublists) follow, one for each line or order:

DEFINE "name [[argument-1 argument-2 ...] [order-1] [order-2] ...]

When the procedure has no arguments, the first list must be the empty list:

DEFINE "name [[ ][order-1] [order-2] ...]

Let us define, for instance, the L procedure to draw the letter of the same name:

DEFINE "L [[ ][BK 30] [RT 90] [FD 15]]

Another procedure, for "L" letters of variable size (EL procedure with argument :SIZE), would be:

```
DEFINE "EL [[:SIZE] [BK :SIZE*2] [RT 90] [FD :SIZE]]
```

The TEXT order is accompanied by a single argument which must be the name of a procedure. The output is the list of instructions of the identified procedure, with a similar syntax to the one described for DEFINE.

In other words, if we order:

```
PRINT TEXT "L
```

we get

```
[ ][BK 30] [RT 90] [FD 15]
```

Similarly:

```
PRINT TEXT "EL
```

gives us

```
[:SIZE] [BK :SIZE*2] [RT 90] [FD :SIZE]
```

If we wished to obtain the instructions for any given procedure in the form of a list of lists, we would write:

```
TO INSTRUCTIONS  :C
OUTPUT BF TEXT   :C
END
```

The INSTRUCTIONS procedure supplies a list of lists of the orders of the procedure we mentioned as argument.

Let us imagine that we wish to construct a new procedure which we call LM, based on the already defined L procedure, in such a way that it will draw the base line of the same letter doubling its length. We could proceed as follows:

```
DEFINE "LM LPUT [FD 15] TEXT "L
```

And also:

```
DEFINE "LM LPUT [FD 30] BL TEXT "L
```

If we had wished to modify the L procedure in order to draw the new letter form, we would have written:

```
DEFINE "L LPUT [FD 15] TEXT "L
```

We would get the same result as before as follows:

```
DEFINE "L LPUT [FD 30] BL TEXT "L
```

Putting two LM together we can construct the new procedure SQUARE:

```
DEFINE "SQUARE [[ ][LM][RT 90][LM]]
```

The simple examples we have seen are an elementary illustration of how, in LOGO, we can construct a procedure starting from other procedures, or how a procedure can be modified. The described examples can be orders included in other procedures and

so on.

Conclusions

LOGO represents an innovation in the field of computers: it is a language different from all others commonly used up to now; it provides different programming modes. In all fields of knowledge, when an innovation appears, a lapse of time is necessary so that its true magnitude can be assessed, as deeply set habits make it difficult to properly integrate such innovation. All innovations tend to be used in the same manner as previously known tools, and such a circumstance restricts their potentialities and advantages. The thorough knowledge of LOGO and the emergence of more powerful versions will contribute to its use in all types of applications, and will confer a new style to the art and science of giving orders to the machines. A style which, in some cases, is very near to the one John von Neumann described more than thirty years ago.

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Logo y las ideas de von Neumann

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RESUMEN

El artículo se refiere a la creación de nuevos procedimientos a partir de procedimientos definidos y guardados en memoria en la forma de listas de listas. La representación de procedimientos en Logo como listas de listas, de tal manera que es posible que nuevos procedimientos puedan construir, modificar y ejecutar otros procedimientos, se compara con los conceptos fundamentales formulados por John von Neumann hace varias décadas.

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TOWARDS A HUMANISTIC USE OF COMPUTERS IN EDUCATION

by Horacio C. Reggini

SEPTEMBER 1983

BUENOS AIRES - ARGENTINA

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Towards a humanistic use of computers in education

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The insertion of computers in classrooms does not necessarily imply an improvement in the quality of education. Its application must be related to an educational conception based upon cognitive aspects of learning which fosters the development of a harmonious relationship among culture, science and human values. The computer must offer favorable conditions so that the student may be the protagonist of his own learning process, fully exerting his creativity.

Towards a humanistic use of computers in education

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Introduction

It is an obvious fact that computers have entered, speedily and thoroughly, into all aspects of contemporary society and, quite often, to be unaware of this fact raises a barrier in our personal and professional development. More and more frequently, we feel the need to penetrate into the world of computers.

In some cases, this need has led to the hasty introduction of computers in the classrooms without a careful analysis of their possibilities as a new educational tool, education being here understood in the most genuine sense of the word.

Frequently, the introduction of computers is made along the lines suggested by merely technical or commercial applications; thus, they are used in class to supply computation power or to allow for a search through huge data-bases or information systems on a given subject. Or they are simply used for students to engage in a pre-programmed question-and-answer dialogue, according to the pattern of computer-aided instruction. These applications have a meager educational content and are, unfortunately, the most widely used.

In general, people believe that the ever increasing availability of technological means for information processing leads to an automatic improvement in the quality of education. That has happened with computers.

In fact, computers, as well as other educational tools, increase the possibility of achieving a better education, but their mere

presence is no guaranty of such a thing. Their use must necessarily go together with an educational thought contemplating, primarily, the cognitive aspects of learning, and tending to the complete fulfillment of the human being.

The absence of definite criteria, of a guiding philosophy, added to the massive irruption of computers in all walks of everyday life, place us in the danger of a wastage of their potentialities and could even have a harmful effect.

The use of computers in education must contribute to the development of intelligence, of personal freedom of choice and of a fraternal relationship among men. Thus, it will help to humanize the world and its structures.

If we want the computer to be used to everybody's advantage, its educational applications should not be restricted to the purely scientific field. They should extend to cultural and artistic spheres and contribute to the consolidation and knowledge of everyday experiences. The so frequently mentioned "Muses" of ancient times, imagination and intuition, which constitute the initial impulse of the act of creation, should be given a place in computer use. The rational thinking demanded at the time of analysis, experimentation or determination of patterns for the accomplishment of a goal should not outweigh the creative aspect, nor paralyze our sensitivity with respect to nature, art and culture.

The LOGO system

Some educators and scientists have approached the subject of the introduction of computers in education earnestly and innovatively.

This can be said of the LOGO system which, as aptly put by its author, Seymour Papert, involves, more than a computer language, a whole educational philosophy. Beyond the immediate results derived from the use of the machine, the final purpose of LOGO is to contribute to the complete development of the human being, which is the goal of all authentic education.

LOGO has certain coinciding points with Piaget's ideas on learning, and it generates a structure through which computers can effectively improve the conditions in which such learning takes place, while respecting, at the same time, the learner's linguistic and cultural identity. We will now analyze some of these principles.

- The child as constructor of his own intellectual structures: From a very early age the child develops coherent theories about the world, "naive theories" through which he explains and understands the real world. In order to be able to formulate these theories, the child appropriates the materials he finds around him for his own personal use. The fact that he does not acquire certain kind of formal knowledge until he reaches a certain age can be attributed, according to Papert, to the relative poverty of his surrounding environment in those materials which would turn some concepts into simple and concrete ideas.

The computer, new Aladin's lamp, with his capacity of becoming any object through a kind of metamorphosis, provides the child with those models he does not find in the real world. Furthermore, if one takes into account that the machine offers the possibility of turning formal thinking into concrete thinking, we reach the conclusion that computers contribute to a more rapid acquisition of this type of knowledge, which implies an unsuspected stimulus towards intellectual development.

Once the child enters school, however, his previous theories about the world clash with the information supplied by teachers and, in general, they are discarded without the child being able to understand the reason. Thus it is that we come up against lessons learnt by rote by students who do not understand what they are saying, with the consequent rejection of that which they have been forced to learn. On the other hand, the system of punishment and reward somehow produces an intellectual paralysis in the learner, who does not dare to hold different views from those of his teacher for fear of committing a mistake and receiving a low mark.

An effective learning requires certain strategies in order to solve these conflicts. One possible solution would be for the teacher to confront what he is going to teach with each student's particular theories on the subject, helping them to discover by themselves why they have made errors in their formulation.

This practice involves the following educational advantages:

1. The child must reflect on what he knows and verbalize it in a coherent, orderly and intelligible way so that he may be understood and thus, be able to defend his ideas. Thus, he will gain self-confidence and an awareness of the power of his ideas.

2. It produces a qualitative approach to knowledge, which is achieved after a long purifying process.

3. Errors are no longer feared; it is of no importance whether what one does is right or wrong, but whether it can be corrected and improved.

4. It encourages creativity, as it makes possible for the child to appreciate, personally and individually, the events of the world. Each individual person interprets things from his own personal viewpoint.

5. It offers children the possibility of being like adults in relation to their intellectual products.

But even though these premises are quite acceptable from a theoretical point of view, to carry them into practice becomes an extremely difficult task in ordinary classes. And in this sense computers, provided with a suitable language, come to offer us their valuable help.

A LOGO procedure - teaching the machine how to do something - is the formalization of a piece of knowledge and its resolution. This formalization is operative, that is, it can be tested, executed and verified. From the computer's viewpoint, a procedure is a sequence of intelligible and executable phrases. From the viewpoint of the person who writes it, it is the expression of the understanding of a concept or a problem, and as that understanding can develop and change, a procedure rarely is a finished product and, therefore, it is subject to changes, improvements and permanent revisions.

In LOGO environments, the student permanently comments on his activities, thoughts and achievements, in talks with his teachers and schoolmates. The role of verbalization is vitally important. For the student, to build a procedure is not only to give a name to a series of instructions: it is an initial passage into abstraction and also the subsequent concrete manipulation of an idea.

With LOGO, students learn to analyze problems, to develop abstractions, to formalize solutions, and to break down the solution to a problem into a series of solutions to subproblems. They also acquire the habit of verifying general solutions in particular cases, of considering errors not as disasters, but as temporary obstacles which must be overcome, and of developing a constructive self-criticism.

- The emotional factor: Frequently, success in learning largely depends not only on intellectual factors, but also on emotional ones. When a child says, "I like geometry" or, "I hate music", he is expressing his ability or inability to assimilate this special type of knowledge into his own set of models.

These intellectual models, peculiar to each person, are acquired in the course of life and their choice is largely influenced by affectivity. It is easy to learn what one likes or understands; otherwise, the acquisition of knowledge becomes extremely difficult. Everything a person learns and the way he does it depends on the models available to him.

It is for this reason that the computer, thanks to its enormous versatility, becomes an extremely effective tool in the learning process, for it is capable of adopting innumerable forms and of supplying models to a great many people with different preferences.

- Besides, knowledge acquires a recognizable personal purpose: The child can do things with it. The steps of school learning are reverted; the computer allows students to come into contact with the practical uses of knowledge, before coming into contact with its formal enunciation.

- Education, when properly understood, must always aim at the child's learning to use his freedom in the most authentic way, a responsible freedom: From an early age the child must progressively exercise his right to choose - under his parents' and teachers' guidance and advice - among the different options offered to him, and to assume the responsibility for his actions and the consequences derived from them, celebrating his accomplishments and correcting his errors.

This is the sense of freedom that LOGO environments intend to achieve. The child feels free in the formulation of his work, in the steps he will follow to reach his goal and according to his own rhythm: he freely organizes his microworld, but he assumes the responsibility for what happens within it.

The preceding statements show how the use of computers in environments such as the LOGO ones presupposes a humanist vision of machines, as their purpose is not that the child draw a merely instrumental benefit from them, but that their huge potentialities contribute towards the full development of human capabilities.

A humanist education

Among the many objections expressed against the introduction of computers in society as a whole and particularly in education, the one most commonly heard is the assertion that the computer develops an excessively logical and scientific thinking, as opposed to the so called "humanistic education".

In order to assess the validity or invalidity of this assertion,

it is necessary to consider that the division of culture into a "humanist" and a "scientific" sphere, so commonly used in some circles, was simply the outcome of a specific historical period. Consequently, it would probably be wise to ask ourselves whether this criterion can be maintained in present times.

That education aiming at a person's integral development, concerned not only with his intellectual growth but also with profound spiritual values - his emotions, his way of establishing relations with others, his imagination - and other physical values, is said to be a "humanist education".

On the contrary, the so called "scientific education" would be the one seeing only to man's technocratic development, exclusively concerned with his intellect and leaving all his other aspects uncared for.

This drastic opposition could have been contemplated in the times when science and technology were laboratory activities, and very few people had access to them. Nowadays, people cannot but come into contact with science and particularly with technology. They are involved in their everyday life. Massive communications media make them share the latest scientific discoveries: technology has penetrated into their working places and their homes. Science and technology are permanently modifying the cultural patterns of modern man.

It is an obvious fact that the world is changing and will continue to change ever more rapidly. For that reason, it becomes necessary to work out, without delay, a coherent educational philosophy to meet the present needs of society and to lay the foundations for the qualification and training of those who will

live and work in future times. This educational thinking cannot leave science and technology aside, but their presence must be governed by a consistent policy that places them in the service of man so that, through them, he shall be able to develop his potentialities in a degree unknown up to now. Therefore, this should be a "humanist" concept of science and technology.

And this is the notion implicit in the LOGO system for the use of computers, the most powerful tool offered by present technology.

The purpose is not that machines shall program people, but that these shall attain a complete and absolute mastery of the former and, through them, shall also learn to know themselves.

The educational method suggested by Greek philosophers - Socrates, Plato and Aristotle - and which was the basis for humanism, has, as a starting point, the legendary advice given by Apollo through the oracle of Delphi: "Know your own self". Socrates and his disciples declare that this is the indispensable requirement to discover later the rest of the universe.

If we compare the educational philosophy of ancient Greeks and the one LOGO proposes, we shall see that their principles share several common points.

LOGO makes it possible for people to reflect their own thoughts onto a computer screen and, thus, to meditate on them. People learn how their minds work and thus attain a deeper self-knowledge. Here, both ends of the opposition we mentioned earlier come into mutual contact.

When we examine some of LOGO achievements in schools, we notice

that some of the more interesting ones are those related with creativity and freedom, two values which are extremely important within a culture of humanistic goals. In a LOGO environment, each student poses his or her own difficulties and, in the search for a solution to them, they find certain patterns that will guide their learning process and become models for the solution to subsequent difficulties. There is freedom in the setting out of problems and in the search of means to solve them. There is creativity in personal interpretations and new approaches to old questions. Knowledge by inference and deduction is encouraged. On many occasions, children form a mental image of what they wish to accomplish and then design ways to achieve it. Some other times, a child starts working with no definite goal in mind, and he discovers something new with each step he takes. His activity resembles scientific research and artistic creation, as the artist often looks in amazement at the result of his own work. Thus, learning becomes a personal adventure.

Resuming the parallel we have drawn between LOGO and the educational system of ancient Greeks, we shall find increasingly important similarities. Plato tells the story of the slave of Meno, who was completely ignorant of geometry matters. Nevertheless, upon answering Socrates' questions, this slave discovered on his own that, in order to build a square twice larger than a given one, it was necessary to draw the second upon the diagonal of the first. The slave made many mistakes, but he corrected himself and was able to draw the right conclusion. Ancient philosophers considered this passage as the educational model par excellence.

Working with a computer under the LOGO system, children conquer a world of which they are the owners and the makers, and where they project not only intellectual factors, but also their likings

and desires. They discover the pleasure of creation. There are no external demands or absolute truths. Freedom and creativity are not refrained by fear of punishment. To make mistakes is not something bad and it is possible to learn from them. Thus, freedom is used with responsibility.

Let us return once again to ancient "humanists". Once more, Plato shows himself as an advanced exponent of modern educational theories, when he says: "A free man can learn nothing that is imposed on him by force". And he adds: "Children learn while playing".

These last thoughts lead us to consider the teacher's role in the learning process. In Greek philosophy, the teacher is the one who guides, who helps the spirit to discover essential truths. The teacher dos not show the truths; instead, he encourages the learner to discover them himself. This is precisely the teacher's role within a LOGO environment.

In the course of these brief and general comments, we have seen how LOGO educational system for the implementation of computers in schools is not opposed to "humanist" education but, on the contrary, it is a new notion of the same which aims at adapting it to a world widely different from that in which Socrates, Plato and their disciples lived.

Contrary to the general belief, its main concern is the student, the learner. The important thing is not the machine but the child who learns.

Learning is a process of development, of analysis and maturing of previous experiences, rather than a storage of information or

skills, and so, computers should be used to help in that process.

It is indispensable that the introduction of computers in education should be properly understood and directed. Such an innovation is only worthwhile if it will make people freer and more creative, and if it will help to improve their intellectual, emotional and social qualities.

New techniques should be intelligently adapted to and introduced into society. Computers are no exception to the need of establishing a congruous relationship among culture, science and human values. The new technology must be understood and guided by humane values; otherwise, it will be difficult to confront the new changes it involves.

Let us hope that computers may accomplish the harmonious reunion of the old and the new, the ordinary and the extraordinary, of intellect and feeling.

ASOCIACION
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HACIA UNA INSERCION HUMANISTA DE LAS COMPUTADORAS EN LA EDUCACION

ING. HORACIO C. REGGINI

SEPTIEMBRE
1983

BUENOS AIRES - ARGENTINA

Hacia una inserción humanista de las computadoras en la educación

Ing. Horacio C. Reggini

La introducción de las computadoras en las aulas no implica necesariamente un incremento en la calidad de la educación. Su aplicación debe estar ligada a una concepción educativa basada en los aspectos cognitivos del aprendizaje que favorezca el desarrollo de una relación armoniosa entre la cultura, la ciencia y los valores humanos. La computadora ha de proveer las condiciones propicias para que el educando sea el protagonista de su proceso de aprendizaje ejerciendo plenamente su creatividad.

Hacia una inserción humanista de las computadoras en la educación

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Introducción

Es evidente que las computadoras se han introducido, rápida y sistemáticamente, en todos los aspectos de la sociedad actual y, muchas veces, el desconocerlas pone una barrera a nuestro desenvolvimiento personal y laboral. Cada vez con mayor frecuencia percibimos la necesidad de entrar en el mundo de las computadoras.

Esa necesidad ha conducido en algunos casos a incorporarlas precipitadamente en diversas aulas, sin un examen profundo de sus posibilidades como nuevos elementos educativos, entendida la educación en su sentido más genuino.

En muchos casos, su inserción sigue las líneas sugeridas por aplicaciones meramente técnicas o comerciales, utilizándose entonces las computadoras en las clases para suministrar potencia de cálculo o para hacer posible la búsqueda a través de grandes depósitos o bancos de datos de información particularizada sobre algún tema. O, simplemente, se emplean para que los educandos entablen un diálogo preprogramado de preguntas y respuestas siguiendo los lineamientos de la llamada instrucción asistida por computadora. Las modalidades de uso citadas poseen escaso contenido educativo pero, desafortunadamente, son las más difundidas.

En general se cree que la disponibilidad cada vez mayor de medios tecnológicos de información lleva a un incremento automático de la calidad de la educación. Esto es lo que está sucediendo con las computadoras. En rigor, éstas, como así también otros instrumentos, aumentan la posibilidad de alcanzar una educación mejor, pero no la garantizan por su mera presencia. Su aplicación debe estar ligada, necesariamente, a toda una modalidad educativa que contemple fundamentalmente los aspectos cognitivos del

aprendizaje y que tienda a la realización de la persona humana.

La falta de criterios definidos y de una filosofía orientadora, sumadas a una invasión masiva de las computadoras en todos los órdenes de la vida cotidiana, nos sitúa ante el riesgo de un desperdicio de sus potencialidades educativas y puede, incluso, llegar a ser perjudicial.

La aplicación de las computadoras en la educación debe coadyuvar en el desarrollo de la inteligencia, de la libertad en la decisión personal y de la fraternidad. De este modo contribuirá a la humanización del mundo y de sus estructuras.

Si queremos que resulte provechosa para todos, la computadora, en la educación, no debe limitarse a lo estrictamente científico, sino que debe extenderse a lo cultural y artístico y contribuir al arraigo y al conocimiento de la experiencia cotidiana. Las tan mentadas "musas" de la antigüedad, la imaginación y la intuición, que constituyen el impulso inicial del acto de creación, han de encontrar cabida en el uso de las computadoras. La racionalidad exigida en los momentos en que se analiza, se experimenta o se fijan pautas para la consecución de un fin, no ha de empañar la fase creativa, ni trabar nuestra sensibilidad respecto a la naturaleza, al arte y a la cultura.

La modalidad LOGO

Algunos educadores y científicos abordaron con seriedad y desde un punto de vista innovador la introducción de las computadoras en la educación.

Inserta en estos lineamientos se encuentra la modalidad LOGO que, como bien dice su creador Seymour Papert, más que un lenguaje de computadoras contiene en sí toda una filosofía educativa. Más allá de los resulta

dos inmediatos que se desprendan del uso de la máquina, LOGO tiene como objetivo final contribuir al desarrollo integral de la persona humana, lo cual constituye la meta de toda auténtica educación.

LOGO tiene algunas coincidencias con las ideas de Piaget sobre el aprendizaje y propicia una modalidad educativa mediante la cual las computadoras pueden mejorar efectivamente las condiciones en que éste se realiza, respetando la identidad lingüística y cultural del educando. Analizaremos a continuación algunos de estos principios..

- El niño como constructor de sus propias estructuras intelectuales: Desde edad muy temprana el niño desarrolla teorías coherentes sobre el mundo, "teorías ingenuas", por medio de las cuales explica y comprende la realidad. Para poder formular estas teorías, el niño se apropia, para su uso personal, de los materiales que encuentra en torno a él. El hecho de que no llegue a adquirir cierto tipo de conocimientos formales hasta alcanzar una edad determinada se debe, según Papert, a la pobreza relativa del ámbito que lo rodea en aquellos materiales que tornarían algunos conceptos en simples y concretos.

La computadora, nueva lámpara de Aladino, con su capacidad de metamorfosearse en cualquier objeto, provee al niño de esos modelos que no se encuentran en la realidad. Si se tiene en cuenta, además, que la máquina brinda la posibilidad de concretar el pensamiento formal, concluimos que las computadoras ayudan a que la adquisición de este tipo de conocimiento se realice rápidamente, lo que significa un estímulo insospechado al desarrollo de la inteligencia.

Sin embargo, una vez que el niño llega a la escuela, sus teorías previas sobre el mundo entran en conflicto con los conocimientos impartidos por maestros y profesores y, en general, son descartadas sin que él logre entender el porqué. Es así como caemos en lecciones estudiadas de memoria por alumnos

que no comprenden lo que están diciendo, con el consiguiente rechazo de aquello que se han visto obligados a aprender. Por otro lado, el sistema de premios y castigos provoca en cierto modo una parálisis intelectual en el educando, quien no se atreve a sostener posturas diferentes a la del profesor por temor a equivocarse y recibir una mala nota.

Un aprendizaje efectivo requiere estrategias para solucionar estos conflictos. Una solución sería que el profesor confrontara aquello que va a enseñar con las teorías particulares sobre el tema de cada uno de los educandos, ayudándolos a descubrir por sí mismos por qué han cometido errores en su formulación.

Esta práctica encierra las siguientes ventajas educativas:

1. El niño debe elaborar su conocimiento y verbalizarlo en forma coherente, ordenada e inteligible para poder ser comprendido y, de este modo, defender su postura. Es así como adquiere seguridad en sí mismo y toma conciencia del poder de sus ideas.

2. Produce un acercamiento cualitativo al conocimiento, logrado después de un largo proceso de depuración.

3. Se pierde el miedo al error; no importa si lo que se hace está bien o mal, sino si puede corregirse y perfeccionarse.

4. Estimula la creatividad, ya que permite la apreciación individual y personal de los sucesos del mundo. Cada individuo interpreta las cosas desde su propia óptica.

5. Ofrece a los niños la posibilidad de asemejarse a los adultos en relación con sus productos intelectuales.

Pero si bien estos postulados son muy aceptables desde el punto de vista

teórico, llevarlos a la práctica se convierte en una tarea sumamente difícil en las clases habituales. Y en este sentido las computadoras, provistas de un lenguaje adecuado, llegan a ofrecernos una valiosa ayuda.

Un procedimiento LOGO -enseñarle a la máquina cómo hacer algo- es la formalización de un conocimiento y su solución. Esta formalización es operacional, es decir, se puede probar, ejecutar y verificar. Desde el punto de vista de la computadora, un procedimiento es una secuencia de frases inteligibles y ejecutables. Desde el punto de vista de la persona que lo escribe, es la expresión de la comprensión de un concepto o problema, y ya que esa comprensión puede evolucionar y variar, un procedimiento es pocas veces un producto terminado y, por lo tanto, está sujeto a modificaciones, perfeccionamientos y revisiones continuas.

En los ámbitos LOGO, el alumno continuamente comenta sus actividades, pensamientos y éxitos con su maestro y con sus compañeros. El papel de la verbalización es de vital importancia. Construir un procedimiento, para el educando, no es sólo dar un nombre a una serie de instrucciones: es un pasaje inicial a la abstracción y es también la manipulación concreta posterior de una idea.

Con LOGO los educandos aprenden a analizar problemas, a elaborar abstracciones, a formalizar soluciones, y a dividir la solución de un problema en una serie de soluciones de subproblemas. Adquieren asimismo el hábito de verificar soluciones generales con casos particulares, de considerar a los errores no como desastres, sino como obstáculos temporarios que deben ser superados, y de desarrollar la autocrítica constructiva.

- El factor emocional: Muchas veces la adquisición de un conocimiento depende en gran medida de factores no sólo intelectivos, sino también afectivos y emocionales. Al decir "me gusta la geometría" u "odio la música" el niño está manifestando su capacidad o incapacidad para asimilar este tipo especial

de conocimiento a su propia colección de modelos.

Estos modelos intelectuales, propios de cada individuo, se van adquiriendo a lo largo de la vida, y en su elección influye en gran medida la afectividad. Es fácil aprender lo que a uno le gusta o lo que entiende; de otro modo, el acceso al conocimiento se torna sumamente difícil. Lo que un individuo aprende y cómo lo aprende va a depender de los modelos con que cuenta.

Es por eso que, debido a su gran versatilidad, la computadora se convierte en un medio sumamente eficaz para el proceso de aprendizaje, puesto que es capaz de tomar innumerables formas y proveer de modelos a muchísimas personas con diferentes gustos.

- El conocimiento adquiere, además, un propósito personal reconocible: El niño puede hacer algo con él. Los pasos del aprendizaje escolar se invierten; la computadora permite a los alumnos entrar en contacto con las aplicaciones prácticas de los conocimientos, antes que con sus enunciaciones formales.
- Toda educación bien entendida debe tender a que el niño aprenda a hacer uso de su libertad en el sentido más auténtico, libertad con responsabilidad: Desde sus primeros años el niño debe ejercitar, en forma progresiva, su derecho a elegir -con la guía y el consejo de sus padres y profesores- entre las distintas opciones que se le ofrecen, y a hacerse responsable de sus actos y de las consecuencias que acarree su elección, festejando los aciertos y corrigiendo los errores.

Este es el sentido de libertad que se quiere lograr en los ambientes LOGO. El niño se siente libre en la formulación de sus trabajos, en los pasos a seguir para la consecución de un fin y cumpliendo su propio ritmo: organiza su microcosmos en libertad, pero asume la responsabilidad de lo que sucede en él.

Los enunciados anteriores muestran cómo el uso de computadoras en ambientes como los de LOGO presupone una visión humanista de las máquinas, puesto que su fin no es que el niño se sirva de ellas simplemente en forma instrumental, sino que sus grandes potencialidades ayuden a desarrollar plenamente las capacidades humanas.

La educación humanista

Entre las muchas objeciones que se hacen a la introducción de las computadoras en la sociedad en general y en la educación en particular, la más frecuente es la afirmación de que desarrollan en las personas un tipo de pensamiento excesivamente lógico y científico, en oposición a la llamada "educación humanista".

Para determinar la validez o no de esta afirmación, hay que considerar que la división de la cultura en "humanista" y ""científica", tan mentada en algunos círculos, fue producto de un momento histórico determinado. Por lo tanto, cabría preguntarse si este criterio puede ser mantenido en la actualidad.

Se considera "educación humanista" a aquella que tiene en cuenta el desarrollo integral del hombre, preocupándose no ólo de su desenvolvimiento intelectual, sino también de sus valores espirituales, como la afectividad, la manera de relacionarse con los demás, la imaginación y otros.

Por el contrario, la llamada "educación científica" propendería al desarrollo esencialmente tecnocrático del hombre, teniendo en cuenta solamente su intelectualidad y descuidando los otros aspectos.

Esta oposición tan tajante pudo haber sido considerada en aquellos tiempos en que la ciencia y la tecnología eran tareas de laboratorio y en los que muy poca gente tenía acceso a ellas. Hoy por hoy, el hombre no puede evitar entrar en contacto con la ciencia y, en forma especial, con la tecno-

logía; convive con ellas cotidianamente. Los medios de comunicación masiva lo hacen partícipe de los últimos descubrimientos científicos; la tecnología ha entrado en las casas y en los lugares de trabajo. La ciencia y la tecnología modifican permanentemente los patrones culturales del hombre moderno.

Es evidente que el mundo cambia y que va a seguir cambiando cada vez más rápidamente. Por ello, se hace necesaria la formulación inmediata de una filosofía educativa coherente que responda a las necesidades actuales de la sociedad y siente las bases para preparar a aquéllos que van a desenvolverse en el futuro. Esta nueva concepción educativa no puede dejar de lado a la ciencia y a la tecnología, pero el ingreso de éstas debe responder a una política coherente que las ponga al servicio del hombre para que, por su intermedio, pueda desarrollar sus potencialidades en grados desconocidos hasta el momento. Se trata, entonces, de una concepción "humanista" de la ciencia y la técnica.

Y esta es la postura de la modalidad LOGO para la utilización de la computadora, la herramienta más poderosa que nos ofrece la tecnología en la actualidad.

No se pretende que las máquinas programen a las personas, sino que éstas logren un dominio total y perfecto sobre aquéllas y, por su intermedio, aprendan también a conocerse a sí mismas.

El método educativo propuesto por los filósofos griegos -Sócrates, Platón y Aristóteles- y que sirvió de base al humanismo, tiene su punto de partida en el legendario consejo de Apolo por medio del Oráculo de Delfos: "Conócete a tí mismo". Sócrates y sus discípulos afirman que éste es el requisito necesario para descubrir después el resto del universo.

Si comparamos la filosofía educativa de los antiguos griegos y aquélla propuesta por LOGO, veremos que sus principios tienen varios puntos en común.

LOGO permite reflejar en la pantalla de una computadora los propios pensamientos y, de este modo, meditar acerca de ellos. Las personas aprenden cómo funciona su mente y logran así un conocimiento mayor de sí mismas.

Los dos polos de la oposición han adquirido aquí un punto de contacto.

Si analizamos algunos de los logros obtenidos con LOGO en las escuelas, vemos que algunos de los más interesantes son los relacionados con la creatividad y la libertad, valores muy importantes dentro de una cultura tendiente al humanismo. En un ambiente LOGO, cada educando plantea sus propios problemas y, en la búsqueda de respuestas a ellos, encuentra pautas que le sirven de eje para el proceso de aprendizaje y que se convierten en modelos para la solución de problemas posteriores. Hay libertad en la formulación de problemas y en la búsqueda de medios para resolverlos; hay creatividad en las interpretaciones personales y enfoques nuevos para viejas cuestiones; se estimulan los conocimientos inductivos y deductivos. El niño, muchas veces, imagina aquello que quiere lograr e inventa caminos para alcanzar su propósito; otras, comienza su tarea sin proponerse una meta fija, descubriendo algo nuevo a cada paso. Su trabajo se asemeja a la investigación científica y a la creación del artista que se sorprende a menudo ante su propia obra. El aprendizaje se convierte así, en una aventura personal.

Si volvemos al paralelo entre LOGO y el método educativo de los antiguos griegos, encontramos semejanzas cada vez mayores. Platón narra una anécdota sobre el esclavo de Meno, ignorante total de los problemas de la geometría, pero que, al responder a las preguntas formuladas por Sócrates, descubrió por sí mismo que, para construir un cuadrado dos veces mayor que uno dado, era necesario hacer el segundo en diagonal respecto del primero. El esclavo cometió muchos errores, pero se corrigió a sí mismo y pudo llegar a la conclusión correcta. Este pasaje fue considerado por los filósofos antiguos como el modelo educativo por excelencia.

El niño, con la computadora en la modalidad LOGO, conquista un mundo del cual es dueño y artífice y en él proyecta no solamente factores intelectivos, sino también sus gustos y anhelos. Descubre el placer de la creación; no hay imposiciones externas ni verdades absolutas. La libertad y la creatividad no se ven frenadas por el temor al castigo; equivocarse no es malo y se puede aprender de los errores. Se ejerce así la libertad con responsabilidad.

Volvamos nuevamente a los antiguos "humanistas". Platón anticipa una vez más las modernas teorías acerca de la educación y dice que "un hombre libre no puede aprender nada si se lo imponen por la fuerza". Y añade: "Los niños aprenden jugando".

Estas últimas reflexiones nos llevan a considerar la función del maestro en el proceso de aprendizaje. Para los griegos, el maestro es el guía, el que ayuda al espíritu en el descubrimiento de sus verdades esenciales. No muestra las verdades, sino que provoca que el alumno pueda descubrirlas por sí mismo. Es ésta la función que realiza el maestro en un ambiente LOGO.

Hemos visto a través de estas consideraciones, muy rápidas y generales, cómo la modalidad educativa LOGO para la implementación de computadoras en las escuelas no se opone a la educación "humanista", sino que, por el contrario, ofrece una nueva visión de ésta para adaptarla a un mundo muy diferente de aquél en que vivieron Sócrates, Platón y sus discípulos.

Contrariamente a lo que se cree, su objetivo principal es el alumno, el sujeto que aprende. No importa la máquina sino el niño que está aprendiendo.

El aprendizaje es un proceso de evolución, de elaboración y de maduración de experiencias anteriores antes que una acumulación de información o de

habilidades, y las computadoras han de utilizarse entonces para facilitar este proceso.

Es imprescindible que la inserción de las computadoras en la educación esa comprendida y orientada correctamente, puesto que sólo vale la pena si hace a las personas más libres y creadoras y contribuye a mejorar sus cualidades intelectuales, afectivas y sociales.

Las nuevas técnicas deben adaptarse a incorporarse sabiamente a la sociedad. Las computadoras no escapan a la necesidad de establecer una relación íntima entre la cultura, la ciencia y los valores humanos. La nueva tecnología debe ser comprendida y humanamente encaminada; de otra manera, serán difíciles de afrontar los nuevos cambios que trae aparejados. Esperemos que las computadoras -y aquí empleo palabras de nuestro escritor Ernesto Sábato- sirvan para unir armoniosamente lo antiguo con lo nuevo, lo ordinario con lo extraordinario, la razón con lo mágico.